DOCUMENT RESUME

ED 349 958 IR 015 694

AUTHOR Polin, Linda
TITLE (Making) Changes in Teachers' Understanding and Use of Technology for Instruction. Draft.
PUB DATE Apr 92
NOTE 48p.; Paper presented at the Annual Conference of the American Educational Research Association (San Francisco, CA, April 20-24, 1992).
PUB TYPE Information Analyses (070) -- Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Adoption (Ideas); *Attitude Change; *Computer Assisted Instruction; Educational Technology; Elementary Education; *Faculty Development; *Longitudinal Studies; Microcomputers; *Qualitative Research; School Restructuring; Teacher Improvement; Video Equipment
IDENTIFIERS Constructivism; Model Technology Schools

ABSTRACT

The longitudinal research reported in this paper took place in a K-8 school setting located in a suburb east of Los Angeles (California). Over a period of five years the school experienced saturation of computer and video technology; state-funded support for change; and (eventually) a restructured organization of the school in support of change. Teachers in this setting were found to vary considerably in their reactions to the environment. This research project relied heavily upon ethnographic fieldwork methodology and to a lesser extent upon more traditional quantitative strategies. The research story unfolds in two parts that are distinguished by differences in control and structure of the Model Technology Schools (MTS) project management. Part I describes a taxonomy of teacher change in the use of technology and categories of support for change as provided by special project staff. Part II describes the last three years of increasing staff ownership and its impact on teacher development. The description of the research study is introduced by discussions of restructuring and technology, changes in change theory, and constructivism and other instructional challenges. Appended materials include a model for a system of teacher development; a report on a conversation with a second year teacher; and notes on unstructured observations and interviews, participant observations, and document content analysis. (Contains 30 references.) (ALF)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

(MAKING) CHANGES IN TEACHERS' UNDERSTANDING AND USE OF TECHNOLOGY FOR INSTRUCTION

ED349958

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☐ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy

Linda Polin

Pepperdine University

I recently had a conversation with a principal visiting the Model Technology School I have been researching for the last five years. He wanted to see what the model school was doing with laptop computers. The principal was convinced he could make great gains in students' writing skills by giving laptop computers to each student.

"But" I cautioned "isn't it really the teacher that improves student writing?"

"No, the computer — it makes it easier to revise."

"How do the kids know what to revise and how to make it better?" We went round and round. Finally I suggested, "why don't you finance your laptops by firing the teachers, after all it's having kids word-processing on laptops that makes them write better."

"Oh, no, can't do that," he said.

"Why not?" I asked, "the software will improve the writing, what do we need the teachers for?"

"Alright I see what you mean."

"No you don't! You still aren't convinced that the teachers have anything to do with the effect of the software. I can't seem to convince you that your money would better be spent on people than on equipment."

He shook his head. "I thought you were <u>for</u> technology."

Ironically, at the beginning of the microcomputer revolution, educators championing computers in the schools were careful to warn that computers would not and could not replace the teacher. Computers would let teachers do things they couldn't do before. Computers, they argued, would further the teacher's reach, provide the teacher, as one company put its, with "the power to be [their] best." This was, I suppose, the educational equivalent to the business world's expectation that desktop computing would let people "work smarter, not harder."

Yet the educational research world has largely ignored this concept, focusing almost exclusively on the interface between student and software, and

120156947

"PERMISSION TO REPRODUCE THIS MATERIAL IN OTHER THAN PAPER COPY HAS BEEN GRANTED BY
Linda Polin
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

BEST COPY AVAILABLE

looking for evidence of impact. For example early research on Logo described treatments in which kids "did Logo" for some specified amount of time, after which their scores on a wide variety of measures were compared to their own baseline scores or to comparison groups who experienced "traditional" approaches to whatever curriculum or skill was being tested (Polin, 1986). Papert (1987), long consider the father of the Logo programming language, condemned this technocentric paradigm, not just for its failure to produce useful results, but more importantly for its trivial view of the learning process.

> *What is THE effect of THE computer on cognitive development? does Logo work? Such turns of phrase often betray a tendency to think of "computers" and of "Logo" as agents that act directly on thinking and learning; they betray a tendency to reduce what are really the most important components of educational situations — people and cultures — to a secondary role. The context for human development is always a culture, never an isolated technology. In the presence of computers, cultures might change and with them people's ways of learning and thinking. But if you want to understand (or influence) the change, you have to center your attention on the culture — not the computer.* — Papert, 1987, p. 23.

Nevertheless the same sorts of studies continue to be conducted as people search for impact from technology, e.g., of programming on problem-solving or word-processing on writing. In reviewing the considerable body of research dedicated to this search reviewers often declare their frustrations that studies contain little or no description of the teacher's methods or purpose (Cochran-Smith, 1991; Palumbo, 1990). This lack of description seems to betray a behavioral theory of learning or a deep misunderstanding of the nature of teachers' work.

> *...we cannot determine how word processing is most effectively used in classrooms apart from the ways particular teachers work in particular*

> *instructional contexts [and] we cannot understand how word processing affects the quality, quantity, or processes of children's writing apart from the ways these are embedded within, and mediated by, the social systems of classrooms.* — Cochran-Smith, 1991, p. 106.

Restructuring and Technology

Interest in the continued development of veteran teachers has dramatically increased in the last five years with the rise of the latest tide of school reform: school restructuring. Restructuring is an umbrella term for a variety of actions and reorganizations at the district, building, and classroom level, the common aim of which is to improve education by driving decision-making power down to its lowest possible level in the belief that "...the closer a decision is made to a student served by the decision, the better it will serve the student" (White, 1989). The purpose of school restructuring is to provide the means for schools to achieve their goals, or as we say in the current vernacular, to "empower" site staff to realize their vision of schooling.

The current school restructuring movement emphasizes many things relevant to teacher development: the influx of new ideas about teaching, the time necessary to absorb and master those ideas, opportunities to share experiences in a collegial atmosphere (Barth, 1991; David, 1989; Sizer, 1992). The restructuring movement puts teachers at the center of school change by giving them the authority, the responsibility, and the resources for making radical changes in schooling. If site staff members are expected to modify and improve the instructional program they must also have means and opportunity to acquire relevant new knowledge and skills. Professional development is a centerpiece of the restructuring effort.

> *The ability of principals and teachers to create better learning environments is a function of their knowledge and skills. The more principals know about good instruction and the provision of useful feedback to teachers, the more effectively they can support and strengthen their schools' learning environments. The more teachers are exposed to new knowledge through formal development activities, informal exchanges with colleagues, and visits to other schools, the more they have to draw on in creating their own effective learning environments.* — David, 1989, p. 31.

A growing number of educators are talking about the role of technology in restructuring schools (Collins, 1990; Pearlman, 1991; Ray, 1991; Sheingold, 1990). They see two roles for technology in the restructuring movement: 1) as a catalyst for change, and 2) as a resource that supports instructional environments and activities that newer cognitive and social learning theories argue are more desirable. Both these roles have implications for teacher development of expertise in technology and in using technology in particular ways. Both these roles raise the issue of school innovation and change.

Changes in Change Theory

The classic RAND study of federally funded projects identified factors which facilitated the "mutual adaptation" process, which they claimed was fundamental to "institutionalized" change. These originally included administrator involvement and support, "critical mass" of participants on site, relevance of project goals to site priorities, training that supports the expected behavioral changes, local materials development, sustained district for implementation, regular and frequent meetings that provided participants the opportunity to participate in planning and decision-making (Berman & McLaughlin, 1979).

While for many years this study stood as a cornerstone of change theory, researchers working the other side of the research paradigm offered alternative explanations for the seeming success and failure of school innovations (Romberg & Price, 1983; Sarason, 1982). Their work recognized that teachers bring to every situation a set of beliefs and values that function as filter through which they view any project or innovation. And, their own classroom realities are further constrained by the larger school setting in which they work.

In a recent article McLaughlin revisited the decade-old study, offering new insights and revised findings that dovetail with the sociocultural view of schools (McLaughlin, 1990). Among the findings she felt needed revision, are two important ones that bear on the research reported in this paper. McLaughlin reported that while initial "grass roots" endorsement and ownership of an innovation does indeed help smooth the implementation pathway, it is possible for belief to follow as a consequence of practice:
"individuals required to change routines or take up new practices can become believers."

> *...the factors that enable practice — productive collegial relations, organizational structures that promote open communication and feedback, and leadership that "manages" opportunities for professional growth and nurtures norms of individual development, for example, – are not amenable to direct policy fixes because they do not operate singly or consistently across settings. Sustained support for effective classroom practice assumes the co-occurrence of these and other enabling factors at the school site. —* McLaughlin, 1990, p.

This would suggest that one powerful factor influencing teacher change is direct experience with new practices. Teachers might begin with a mechanistic enactment of a new method but they may eventually internalize the practice and ideas underlying it. Collins (1990) argues something like this in his examination

of the role of technology in restructuring. Once you let it technology in the door "it will take on a life of its own."

Constructivism and Other Instructional Challenges

Constructivism dignifies learning by positing that all students are active participants in the construction of understanding, that the value of what gets learned is directly related to the meaningfulness of the experiences or contexts which the student encounters. Papert (1990) and others have argued that children are and ought to be treated as epistemologists, that, as epistemologists, they ought to be doing the kinds of tasks that adult epistemologists do. Rather than learning someone else's evaluation of the cause of the Civil War, they ought to be reading original documents, analyzing primary source data, learning the rule of evidence and constructing their own empirical interpretations of history. Rather than digest and practice applying someone else's discovery of math principles and theorems, students ought to be exploring a system of relations and patterns, constructing their own proofs, and deducting their own theorems.

> *We understand 'constructionism' as including, but going beyond, what Piaget would call 'constructivism.' The word with the* **v** *expresses the theory that knowledge is built by the learner, not supplied by the teacher. The word with the* **n** *expresses the further idea that this happens especially felicitously when the learner is engaged in the construction of something external or at least shareable ... a sand castle, a machine, a computer program, a book.*
>
> — Papert, 1989, p.

His definition stands in contrast to instructionism: "Better learning will not come from finding better ways for the teacher to instruct but from giving the learner better opportunities to construct."

Computers, the argument goes, support this kind of learning environment better than any other existing medium (Collins, 1990). Furthermore, by carrying some of the burden of the arrangement and monitoring of the environment, they potentially free the teacher to take on a new role, that of facilitator or co-learner.

In addition to the shift toward a social-interactionist model of learning, the milieu in which education reform operates today includes: cooperative or group learning, thematic or cross-curricular instruction, "authentic" and portfolio assessment of learning, whole language and core literature approaches to language arts , new curriculum standards in math and science, situated cognition or cognitive apprenticeship models of the learning environments, and the assisted-performance elements of Neo-Vygotskiian theory of learning. Many in education believe that the reform of instruction hinges in part upon the successful implementation of these kinds of changes in instruction. They also believe that technology has a very important role to play in brining these change to bear through the micro-restructuring of the teaching-learning process and the macro-restructuring of educational institutions.

There is not yet agreement about the power of technology to influence teachers to make the kinds of changes in their daily practice that are called for by these revised views of learning. While McLaughlin (1990) and Collins (1990) suggest that direct experience is a powerful force in changing minds, David (1990) and Cuban (1988) point out the long history of resistance to change by schools and teachers.

A Study of Teacher Change and Technology Use

The research reported in this paper took place over five years on a K-8 school setting which experienced saturation of computer and video technology, state-funded support for change, and (eventually) a restructured organization of the school in support of change. In this setting teachers were found to be quite variable in their reactions to the environment. It is this variation in influence that makes the study interesting. Different teachers "turn" at different times in the course of the project and under different circumstances.

The research story unfolds in two parts that are distinguished by differences in control and structure of the MTS project management. Part I describes a taxonomy of teacher change in the use of technology and categories of support for change as provided by special project staff, i.e., outsiders on campus. While this work has been reported earlier (Polin, 1990, 1991) it provides a language for discussing events and results in later years and so is recapped briefly in this paper. Part II describes the last three years of increasing staff ownership and its impact on teacher development.

A Context for the Study

For the last five years one average K-8 elementary school has been funded by the state of California to become and sustain itself as a "model technology school." While an initial proposal was submitted in response to the state RFP, the plan did not specify particular interventions, materials, or methods that would be adopted by the teachers on the site. The plan only described what it called a "student-centered" philosophy which the site would use to guide their decision-making and development.

It became evident in the end of year analysis of the first year's field work that the shape and destiny of the project, including any student outcomes or lack

thereof, would be determined in large part by individual teachers chose to do, and that what individual teachers chose to do, would be determined in large part by fellow teachers, principal, and staff as a social group. This social system,and its impact on its members, has been the focus of the past five years of fairly intensive study.

It is still too early to report some final summative statement encompassing all that has been learned in that time. Not all analyses have been concluded, nor all hunches re-investigated. Nevertheless the recursive, cumulative work of the past four years has resulted in data-based "findings" that we believe are very important to share. Those findings describe the development of teacher expertise in technology-based instruction, modifications to practice, and the mechanisms that seem to have supported and in some cases occasioned change.

The District and The School

The City School District is an urban fringe school district east of Los Angeles. The district, once a white suburb, has remained predominantly Latino over the last decade. Within the last five years the district has seen yet another demographic shift with the influx of large numbers of Chinese families and to a lesser extent Korean and Vietnamese. The district actually consists of two districts: an elementary city schools district and a high school district that serves several other small communities. Within the bounds of the elementary and secondary districts there are very few large businesses and industries. In fact, the school district itself is the second largest employer.

The School is a K-8 elementary school isolated in the northwestern corner district. At the start of the project in 1987 it was the smallest, enrolling approximately 480 students. Each year of the MTS project The School has added a temporary, portable classroom, and as of this writing school enrollment stands

at approximately 580 K-8 students. In 1987 the school listed 60% of its students as Latino; 24% as Asian; 1% African-American. Today, those numbers remained virtually the same. This school are generally distinct from the district distribution of minority students, which for the 1989 school year ran 48% Asian, 37% Latino, and less than 1% African-American. Despite the seemingly unchanged character of the school population, The School reported an big increase in the percent of students identified as LEP (limited-English-proficient) at the lower grades, suggesting a deeper change in than ethnicity data might reveal. In 1985-86, only 13.6% of the third graders were identified as LEP; in 1988-89 that figure had risen to 26.5%. Notices at The School are sent home in English, Spanish, and Cantonese.

The Model Technology School Project

According to the grant proposal submitted by the The City School District to the State, the Model Technology Schools project (MTS) would demonstrate that students and teachers in California schools could better implement mandated curriculum frameworks in a technologically enriched setting. The State guidelines asked MTS projects to define and adopt a cohesive, theoretical model of learning (rather than a list of behaviors or activities) to guide implementation and research activities. The MTS specifically planned to develop and maintain a "student-centered approach" to learning, using technology as a "tool for learning."

Each year of the five year project, the project received $500,000. In the first year of funding (1987-88) the project focused almost exclusively on the elementary school. In Year Two (1988-89) the project extended to include the four-year high school that graduates would attend. The level of funding

remained constant throughout, meaning that in Year Two and successive years, resources were shared between the high school and elementary school.

Oddly, this specially focused and highly funded project did not propose a structured intervention. There was no specific software or hardware to be employed. There was no special curriculum outlined and supported. There was no single instructional method or methodology defined and taught. Yet, the project did create and support significant change in every teacher, aide, and administrator involved with the site, though some to a greater degree than others.

A Few Words About Data Collection Methods

This project relied heavily upon ethnographic fieldwork methodology, and to a lesser extent upon more traditional quantitative strategies. The ethnographic methods provided descriptions and documentation of the MTS process as the students, staff, parents, and project team experienced it. Field observations, interviews, and document analyses, enabled researchers to hypothesize and test relationships between components of the projects (people, processes, and materials), and to identify critical factors.

To identify and describe changes in the schools along the lines of student-centeredness and technology integration, the research relied upon a variety of qualitative methods: structured and unstructured observations and interviews, and content analysis of documents such as memos and assignments[1]. Researchers observed students, teachers, instructional aides, administrators, and project staff at hallway computer banks, in classrooms and in the basement lab, at training sessions, and faculty meetings.

The researchers met to discuss the patterns and hunches suggested by their data collection and analyses. These discussions, in turn, raised new issues

that focused successive observations in particular directions. Where data converged and patterns repeated without contradiction it became possible to postulate patterns describing teacher, student, or staff behaviors.

The Context of Part I. For the first year of the MTS project (1987-88), The School had no fewer than six outsiders on-site to support teacher development through planning and conducting training sessions, assisting teachers in the development of appropriate curricula and methods, supplying technical assistance, and generally administering the grant moneys and overseeing activities. In the second year the project lost a full-time person and had to share two other people in the shift to cover the second MTS site. In the third year (1989-90), the school lost another full-time position half-way through the school year.

At the beginning of that third year, two of the more successful teachers (Polin, 1990) stepped forward to volunteer to job-share a sixth grade class and one of the missing project staff positions. One teacher would begin in the classroom while the other worked as a "Facilitator" to help other teachers and to take on some of the burden of project management; at the semester break they would swap positions. This arrangement marked the first step toward an important and inevitable shift of control over the project, and it marks in this paper, the shift to Part II.

The Context for Part II. Everyone connected with the project acknowledged that at the end of the five year grant the "locals" would be on their own. Thus the gradual take over of the project by teachers was seen as a necessary step. They needed to begin understanding the organization or restructuring the organization of the project on the site. Year Four promised the loss of yet another support person, leaving the site with one consultant on curriculum shared with the high school site, one administrative assistant, and a

shared techie. No full-time project consultants in training, curriculum, or technology would be available.

The two lead teachers who had job-shared in Year Three offered the Facilitator plan that was eventually adopted and implemented. The plan called for the conceptual re-organization of the K-8 school into blocks or clusters: K-2, 3-5, 6-8. Each cluster would select two lead teachers to be Facilitators for their cluster. The Facilitators received an a stipend of $4000 which they could take as extra duty pay or use to purchase release time from class. In addition, the Facilitators as a group had a budget for travel and some school-level acquisitions of equipment, supplies, or services (e.g., inservice). Each cluster was given a section of the annual budget to use for equipment, supplies, or services.

Facilitator duties included meeting as a group once a month, convening Grade Cluster meetings as necessary, supporting and advancing the use of technology by teachers in their cluster, and assisting with the dissemination of project information (largely through conference presentations and write-ups of successful "modules"). Research reported here focused on the role the Facilitators played in the further development of their peers and in advancing their own expertise.

PART I: TEACHER TECHNOLOGY USE AND STYLES OF SUPPORT (YEARS ONE & TWO)

Ways of Talking About Changes in Technology Use by Teachers

A number of researchers have characterized the phases or categories of involvement and use of innovations. Romberg and Price (1983) describe three

kinds of change: nominal change, which isn't really change at all, and three levels of "real" change: technical, illusory, and constructive. Nominally changed teachers talk the talk, but they don't walk the walk. They pass in conversation as implementing teachers, but observation of their classroom practices would find them unchanged. Actual change in practices can be technical, illusory or constructive. Technical change is procedural change without deeper understanding. Teachers with this level of implementation quickly run into trouble when things don't go according to the script of expectations. They haven't got the generative resources for carrying out alternative routines. This sort of change shows up in many classroom enactments of curriculum reform, e.g., whole language. Illusory change is more subtle in its failings, and frankly more common in computer projects. If technical change represents the teachers lack of understanding, illusory change represents the teacher's lack of conviction: "We'll do it, but we don't think it's going to matter." The ideal kind of change is constructive change, which Romberg and Price identify as deep understanding of the intention as well as the procedures of an innovation: informed practice. An indication of this level of understanding and implementation is the adaptation of the project to suit local conditions while remaining true to its purpose.

Dwyer, Ringstaff, and Sandholz (1990a&b) find a five stage model useful in describing the evolution of ACOT project classroom computer use: entry, adoption, adaptation, appropriation, and invention. Entry describe the first encounter with the installation and classroom management issues that computers bring. Adoption the next phase in which technology is harnessed to traditional instructional methods and purposes; but at least it's being used. The next phase represents a significant step toward understanding the potential of new technologies; Dwyer et al. refer to it as the Adaptation stage in which the teacher and students make use of productivity tools, e.g., word-processing.

Students show a deeper engagement with the instructional uses of the computer. The fourth stage is Appropriation. In this stage, which they claim was reached in the second year of the project by all teachers, "team teaching, interdisciplinary project-based instruction, and individually-paced instruction became more and more common." For these teachers "computers [had] become natural tools with which to work." The last stage, Invention, describes a level of expertise that extends well beyond the integrated use of technology to reconceptualizations of curriculum, methods, and assessment. Dwyer et al. acknowledge this category is a "place holder" for future teacher development.

The ACOT stages almost map onto the Romberg and Price categories of change, but not quite. Dwyer et al. are describing the evolution of computer environments and Romberg and Price are describing the categories of implementation of innovation. The ACOT categories represent a developmental continuum; Romberg and Price describe four types of change. There are some similarities. The changes in classroom practice, or rather the lack of meaningful change, described in the ACOT Adoption stage sounds much like Illusory Change. The Adaptation stage echoes some of the ideas of the Technical Change: procedure is altered, people don't quite seem to get the "big idea" but they seem to know that and aren't resistant. The Appropriation and Invention stages seem to exact match the Constructive Change described by Romberg and Price.

The Romberg and Price taxonomy does map quite well onto a taxonomy of teacher change developed from the MTS project. The research and evaluation data from the first year suggested a hierarchy of four categories marking successively deeper engagement with technology. In Year Two researchers were able to check the validity of this four-level hierarchy by continued observation and description of teachers' technological expertise and

instructional applications. As teachers continued to change in Year Two it was possible to check to see if the changes they made followed the sequence represented in the four step model. These data supported the initial hypothesis. A second source of confirmation came from the observation of two "new" teachers who joined the project in the second year. They too exhibited the same direction and sequence of observable change in their classroom uses of technology.

The Comfort Zone

The first interactions with technology on the site can largely be characterized as "getting acquainted" and comfortable with the basic operations of equipment. Moving into the comfort zone meant demonstrating a willingness to use equipment with students, or sometimes, only a willingness to have students use equipment, i.e., without teacher support. All teachers reached the comfort zone with at least one piece of technology in their first year .

This "comfort zone" did not demand much technological or instructional sophistication from teachers. Originally, the "comfort zone" was operationally defined as able to start and stop video or computer equipment at will. Comfort Zone teachers were willing, even resigned, to experience problems while using equipment if those problems were occasional, and quickly resolvable by staff or students. In a few instances, early Comfort Zone behavior included allowing students to use equipment that the teacher herself had not mastered, or in some cases, had not tried out. These unsupported forays into technology by students generally occurred on the basis of privilege earned by virtue of native intelligence, "good student" status, or free time. This sort of student use was never seen at the whole class level, and never for more than five or six students at one time.

Life in the Comfort Zone was, well, comfortable. Teachers did not make any modifications in their classroom instruction. "Computers" took on the status of an additional curricular topic; there was the sense that they needed to be "covered," that there were things kids should be "exposed to." The sense and use teachers made of equipment seemed to depend on what was available to run on it or what activity someone had prepared for them to use, rather than on any deliberate attempt to formulate an instructional purpose.

In the comfort zone videodisks were used with little explanation, apparent purpose, or follow-up for students. Teachers readily embarked on LogoWriter lessons prepared for them with the only apparent goal being to learn the software. Students in the hallways worked on FrEdWriter or Top Draw amusing themselves; their products were not saved, collected, or reviewed by their teachers.

Disjointed Instructional Use

Now in Year Five, it is evident that all but the newest arriving teachers have moved beyond the Comfort Zone, and even some of them have demonstrated their ability to escape from the Comfort Zone in just their second year with the project. Teachers emerging from the Comfort Zone asked for software in particular subject areas; they reviewed software packages before checking them out for the classroom. They talked about computer time in terms of curricular subjects, such as mathematics, science, writing. Some even refined their labels to subtopics within subjects, such as multiplication, shapes, paragraphing.

The nature of the tasks students engaged in looked different too. Students worked on computer as part of instructional time, rather than as a new curricular topic or personal reward of free time. While teachers still favored

highly focused courseware (CAI), increasingly they allowed students to use applications (word-processing) or utilities (graphics) to complete writing assignments or reports. Students might still be learning LogoWriter commands, but now the tasks had the façade of math or language arts activities. Students might use word-processing software, but they used it to enter and print previously composed and teacher-edited prose, thus employing the computer much like a self-correcting typewriter to copy over neatly correcting errors.

In retrospect it is tempting to rename this "place" in the continuum "The Passing Zone," for it is here that people look like they are doing what they think they are supposed to look like they are doing. They are "passing." Yet, computer and other "MTS project" time is not really functionally relevant to classroom instruction. Work completed on the computer does not "count" for anything in the grade book; it does not move the curriculum along. At best, in the Passing Zone, kids get extra practice on old knowledge and project staff members don't lean on you so much to do more and different things. In the Passing Zone, you "pass" as an implementing teacher.

Integrated Instructional Use

In spring of Year One (1988), the MTS staff discussed summer training plans. All agreed that it was critical to move faculty more directly onto the student-centeredness path. They agreed that the three full days of train would down play technology, even omitting it from the first two days of training. Instead teachers would see models of how to plan a cross-curricular, student-centered project. They would be asked to form collaborative groups for planning, and they would have frameworks, texts, and other resource materials available to help them plan.

This describes the look and feel of life in the Integrated Use Zone in which teachers make planned use of technology to accomplish instructional goals. Teachers operating at this level can find opportunities to "fold in" a technological task in a meaningful way. At this level, unlike the previous two, work done with the aid of technology "counts." And, not only does it count, teachers believe it facilitates the accomplishment of learning.

Teachers in this zone have "arrived." On campus they are socially marked as "successful" by the principal, the outside project staff, and reflexively by other masterful teachers. They are asked to share their ideas in meeting; their classroom activities are described in-house newsletters; they are urged to speak at conferences, and otherwise clearly identified as a member of those who are "doing it." Typically these teachers have one or two favorite technologies or software packages that they rely upon. Most often these are *LogoWriter,* some word-processor, a "canned curriculum" package such as *Kids' Network* science units or the *Voyage of the Mimi.*

Teachers operating at this level of familiarity and confidence are expected to be able to support their peers through formal "training" or staff development, and through informal mentoring and collaboration. In the parlance of Years Four and Five, such teachers would be eligible to serve as "Facilitators."

Transparent Integration

Originally this level represented the MTS goal for instructional technology. At this level, students and teachers employ a variety of technologies as the means to accomplish some curricular purpose, but this use of technology tools is automatic, much like the current use of the chalk board. Thus, technology is no longer visible as a separate element of planning. Teachers no longer search for place to "insert" technology; nor do they search for and construct instructional

meaning for a given technology. Rather they choose "high tech." tools when they perceive them to be more effective or efficient than "low tech." ones.

This zone is unlike the previous three because it is characterized by substantive change in instruction as a function of technology tools selected for use. Here teachers' instruction is thematic, project-oriented, employs group work, and has a strong constructivist orientation. Teachers here eschew CAI in favor of tool software, simulations, database, and construction materials: *Lego Logo, HyperCard,* desktop publishing (as opposed to the *Writing Center* or *Children's Writing and Publishing*), CD databases. These characteristics have been articulated by project staff as the components of student-centered instructional use of technology.

Teachers operating at this level of familiarity and confidence can support their peers through formal "training" or staff development, and through informal mentoring and collaboration. However, they are more likely to talk about the instructional strategies and content of than the technologies. For them, technologies have become transparent and less interesting as topics in themselves.

The Nature of Help: A Taxonomy of Supportive Interactions

Over the five years of the project there have been a number of changes in the configuration of support staff, and these changes have affected the kinds of support available on campus. Each year of the project has brought a continuing gradual decrease in the number of outsiders paid to support the site. In Spring of 1992, the fifth and final year of the project there is only one part-timer left on site from the original four outsiders whose full-time job it was to support teachers

on site through curriculum development and training. That part-timer is focused more on the construction of units for dissemination than on teacher assistance.

Observations of and interviews with MTS team members and school teachers revealed sharp distinctions in the nature of "support" available to teachers by the people on the site. Four kinds of support described here in very brief overview are called: a) directive, b) consultative, c) collaborative, and d) reflective. The variations among categories arise along several dimensions: a) source or initiator of contact; b) party primarily responsible for success or failure; c) relationship to teacher; d) source of instructional focus; e) product structure; f) content of transaction between specialist and teacher. These dimensions defined the nature of the relationship between the teacher and specialist (reported in grater detail in Polin, 1990).

As the outsider consultants left, teachers on site constructed and revised a formal structure for assuming control and responsibility for the project (discussed later in this paper). Even after the project shifted from outsider support to insider support these categories remained valid and useful for describing teacher interactions. Thus while the range of support styles has decreased with the loss of particular people who enacted those styles, other style categories have become more fully describable because of their continuation by a changing cast of characters.

Directive Intervention

Two members of the original four support staff viewed their job as preparing and disseminating lessons or activities. They approached teachers directly, without waiting to be solicited. They gave teachers instructional materials, such as dittoes, diskettes, and lesson plans. They sometimes taught a class lesson or led an activity for a teacher, with the teacher present but not

participating. They did not follow-up on lessons or activities left with the teacher, and rarely did the teachers working with these supportive staff seek them out when an activity went awry.

Directive staff tended to develop and disseminate activities and lessons that focused on lower level objectives and discrete skills. In the area of technology use, the mastery of the equipment or knowledge of how to use the software was often the objective. Students learned *LogoWriter* to learn *LogoWriter*. The source of instructional focus was the curriculum, limited only by the expertise of the specialist. They talked about "transferable" instructional lessons that could be used elsewhere in the school or district.

Teachers' main complaint was about the quality of the lessons when lessons went didn't work as planned. However, for the most part teachers working with directive staff were pleased with the help they received. These teachers tended to talk about the activities and lessons developed and led by the support staff as their own. This seemed to give them a "right" to feel that they were implementing the MTS project. In Year One, these teachers often had technology activities going before other teachers did, although clearly they depended upon the support staff for those activities.

Teachers who were best described as in the Comfort Zone were the primary clients of Directive Support staff. The "directive" support provided to teachers in the "comfort zone" was a double-edged sword. It serves to involve students and teachers who might otherwise remain uninvolved in technology applications. Unfortunately, the nature of the involvement this model generates was compromised by the support person's tendency to create "generic" lessons that had little direct relationship to classroom instruction. Indeed, a "computer literacy" approach may even predominate.

Consultative Assistance

The supportive staff who fell into this category viewed their job as solving problems and giving advice, i.e., consulting. They did not approach teachers, but rather waited for teachers to come asking for help. Most of their activity was directed toward obtaining and distributing materials when requested, finding out information in response to a question, and solving technical problems (or referring problems to district level specialists, e.g., to repair disk drives). They did not teach classes with or for teachers. They did not offer fully developed ideas or lesson plans, though they might suggest ordering or using a particular videotape or software package. These supportive staff members assumed a very powerful role as "gate-keeper" of knowledge and resources. When given a problem to solve, these people solved it and returned with the answer, rather than involve the teacher in the solution process. Teachers' main complaint about this sort of support arose when materials and solutions were not received in a timely manner. For the most part teachers receiving this sort of support were quite pleased with it, though the support staff operating in this manner tended to report teachers needled them or became "too demanding."

Collaborative or Negotiated Constructions

The supportive staff who fell into this category usually approached teachers formally (by arranging appointments) or informally but directly (during social settings such as recess break in the staff room). On some occasions they might also begin their collaboration when approached first by a teacher. Collaborative support staff asked questions about what that teacher was currently doing in class and generated ideas based upon the teacher's response. Those ideas might be rejected or modified by the teacher. They did not teach for or with the teacher, but they did visit classrooms occasionally to chat about or

watch the planned lesson. They always knew when the teacher was scheduled to do the planned unit and always followed-up during or after implementation by asking questions. They used their own expertise about teaching and technology to guide and focus a teacher's decisions. This meant they did not always choose to accept and extend every idea teachers came up with, and often spent considerable time and talk to "help the teacher see" the problems with what they considered to be inappropriate choices and plans. Teachers main complaint with this approach was the amount of time required to generate a single unit of instruction. Though, without exception, teachers supported in this manner carried out instructional plans they were clearly proud of and considered largely successful.

Reflective or Collegial Dialogue

None of the support staff on the project fell into this category until the creation of "facilitators" in Year Four. Originally this category was derived from analysis of interactions between the researcher and the teachers involved in the case studies. These teachers made remarks on a number of occasions to a variety of audiences that they "could not have done it without [the researcher]." The researcher offered no help, provided no materials. When the teachers who made these remarks were asked about their comments they reported that "simply by being there" and asking questions the researcher was "showing an interest" and provided "moral support" during what teachers considered to be risky instructional moments. The researcher's questions caused these teachers to "think about" what they were doing and why. Teachers main complaint is lack of evaluative feedback on their efforts.

The researcher had observed in classrooms intermittently throughout an instructional unit (e.g., anywhere between two and twelve weeks). In addition to

noting observations, the researcher had informally discussed teachers' instructional processes, plans, decisions, interactions with students by asking questions such as: why did you do this; how did you know that; what will happen next; where did you get the idea to do that; tell me about him or her. The researcher had shared field notes with teachers on their request (which was rare); passed information between teachers often inadvertently; and asked instructional questions during social occasions (e.g., in the staff room during recess). Interactions with teachers were non-evaluative and non-directive; and teachers rarely asked the researcher questions or advice. On the other hand, they frequently approached the researcher in the hall or elsewhere to report on anecdotes about their classroom which reflected things they were proud about, surprised by, amused by, or frustrated with. This seemed to create a kind of on-going reflection about practice (Schon, 1983).

These teachers seemed to be the most completely engrossed in their own experimentation. They had few complaints about site support, even though they generally appeared to request or expect much of it. Teachers who reported the impact of the "reflective" researcher also tended to "hang out" together, to share the same instructional values and beliefs. They also tended to be among the more "active" teachers at the school, e.g., working on school and district committees, voluntarily and eagerly sharing their successful experiences.

This category is not facetious. In successive years as a group of lead teachers, called "facilitators," took over management and support functions in the project, they created an atmosphere for reflection among themselves. Many of their management meetings were partially taken up with discussions of their won experiences, their thoughts about what they or others were doing, and with their own struggle to articulate for others the principles of a student-centered, active learning use of technology.

Relationships between Teachers' Technology Use and Support Styles

What is the relationship among the categories of technology use, and between those levels of use and the different support styles? Is there a developmental progression? Observations suggested that teachers did not necessarily progress from one level to another in a straight linear sequence. At least two teachers moved from "Comfort Zone" to coordinated instructional use, skipping over "Disjointed Instructional Use." However, these teachers experienced "collaborative" support while hiding out in the comfort zone in Year Two. Their collaborators reported working with the teachers to explicitly state principles and goals for technology use and to recognize or mark in their own experiences the functional relevance technology use. In a very real sense these teachers worked through disjointed instructional use in dialogues with their project assistant.

While the levels of use did not seem to follow in a progression, the support styles did seem to interact with the level of teacher technology expertise. The collaborative model was effective in moving teachers toward truly purposeful uses of technology as a tool for accomplishing curriculum. Unfortunately, it was extremely costly, requiring extensive one-on-one work between teachers and their support person. Also, unlike the directive method of support , collaborations did not necessarily produce "generic" lessons or ideas that can be easily transported to other classrooms or sites. What was produced, was closely tied to the needs and emphases of the teacher, given the resources and students he or she was working with. Without an exception, instructional ideas generated from collaboration as described here were actually implemented and deemed successful by the teacher. Indeed, the project research found these teachers in succeeding years able to generate similar projects without support. That is, they

appeared to have acquired some generative principles they could apply to instructional technology use.

Nevertheless the collaborative approach was not a sure thing. Several teachers, most notably those in or barely in the "Comfort Zone" were resistant to advances from the collaborative support staff. In one case, the teacher perceived the collaborations "insulting" since he "knew how to teach!" In another instance, the resistance was more a passive avoidance of broken appointments and "miscommunications." The teacher talked about being "nervous" about trying more things. Teachers who are just getting comfortable with technology in their classroom life preferred "directive" support, in which the burden for making things work is carried by the outside assistant. This might parallel common experiences elsewhere, when, for example, teachers bring their classes to the computer lab where class is led by the computer coordinator or where the classroom teacher enacts a lesson created by the computer coordinator.

The "Directive" support provided to teachers in the "Comfort Zone" was a double-edged sword. It serves to involve students and teachers who might otherwise remain uninvolved in technology applications. Unfortunately, the nature of the involvement this model generates is compromised by the support person's tendency to create "generic" lessons that have little direct relationship to classroom instruction. Indeed, a "computer literacy" approach may even predominate. Furthermore, directive support actually may carry too much of the task for the teacher, largely preempting his or her opportunity to acquire more instructional and technological skills and understandings. To move to the more desirable uses teachers needed more than directive support as directive support seemed to lead them toward disjointed instructional use in which they assumed responsibility for their own instruction, but, lacking ideas, rely upon the inherent instructional value in the software or materials.

The consultative form of support is actually very cost-effective for teachers who know what they want to do and feel confident about their technology skills and knowledge. For teachers in the "Comfort Zone," this method of support goes unused. These are teachers who do not know to do, and thus cannot ask for materials or solutions to do it. For teachers in the disjointed instructional use category, this sort of support can be disastrous since it does absolutely nothing to help those teachers move their technology use closer to their instructional goals and needs. In fact, the consultative method can actually be viewed as an obstacle to growth since it tends to hoard expertise and access to resources, creating "gate-keepers" of technology. Thus it would appear most appropriate for teachers who are described as "coordinated" or "transparent" technology users.

The support methods and technology use categories reflect teachers' beliefs about themselves as teachers, their students as learners, and technology as an instructional method. Teachers behave in concert with their beliefs (Erickson, 1986). To the extent that a support method provides or allows for ratification of teachers' beliefs, it precludes any "change" in teachers' behavior. The collaborative and the reflective methods present teachers with a clear vision of themselves and their students using technology to accomplish meaningful classroom goals. It guides teachers through the experience, "marks" its occasion and critical features, and reinforces that experience through discussion and reflection. Teachers experiencing either directive or consultative support do not experience any alteration in their currently held beliefs about themselves as technology-users and their beliefs about the functional utility of technology. Indeed, they can find in generic directive lessons confirmation of their beliefs that technology is only tangentially related to curriculum, minimally useful in

accomplishing instructional goals, and therefore, not worth much personal investment.

PART II: A SOCIAL SYSTEM OF SUPPORT FOR TEACHER DEVELOPMENT (YEARS THREE THROUGH FIVE)

The ultimate "empowerment" of teachers began in part in Year Two with the loss of one full-time curriculum and training person to the high school. Also in Year Two the technical support person cut back from full-time at The School to half-time at each of the two sites. The loss of the technical help was partially offset by the immense growth in expertise on the part of the MTS project administrative assistant, mostly from direct experience. There were few problems she could not solve for them. Teachers still felt the effects of these cut-backs initially. However, as the school year wore on they found additional technical support in each other and in their students and instructional aides.

The loss of support in instructional planning and implementation was not as easily recouped, and Year Three brought even more "cut backs." Another of the curriculum and training staff members left the site. She had been the sole staff member using the "collaborative" approach to teacher support. Considering the benefits from that approach in Year Two, her absence was considered a real loss. Another support staff member had a baby during the summer between Year Two and Three, and came back part time, two days a week.

Two teachers stepped forward to "job share" a "facilitator" job in hopes of easing the loss of support staff . They offered to team-teach a sixth grade class. In the first semester, Kate would function as a "facilitator" and in the second half of the year, Nora would. In retrospect this stop-gap measure intended as a

temporary fix actually marked the beginning of the "restructuring" of the site in terms of responsibility, support, and authority.

At the end of the school year Nora and Kate felt the teacher-as-facilitator plan was working well. Nora devised a plan to make use of the moneys that had previously gone to pay for the support staff positions the school had lost. Her idea was to designate six teachers as project facilitators. These teachers would be responsible for a cluster of grades, two facilitators for each grade cluster: K-2, 3-5, 6-8. The facilitators would receive extra duty pay and release time. They would guide the purchasing and planning decisions for their cluster, which would have its share of the project budget to spend.

At one of the last faculty meetings of the year The School principal, Nora, and Kate explained the idea. The faculty discussed it briefly, broke up into grade level groups and selected two facilitators. There was some undercurrent of anxiety about the selection process. At the end of the meeting, after the selections were announced, Nora confided that things had gone as she had hoped. "All the right people got selected."

In the fifth year (1991-92) five of the original six facilitators were re-selected. The sixth begged off because she was pregnant and would be taking a leave in the second half of the school year. Rather than replace her with an "inappropriate" selection, the Facilitators remained only five.

Thus, in the last two years of the project (Years Four and Five), MTS was run by lead teachers. With the Facilitator teachers in charge, the resources for further teacher development actually increased, largely due to the powerful influence of an evolving culture of system in which Facilitators had a central role.

This section of the paper describes that system (or "culture") on the site and how it functioned to influence teachers on site (see Figure 1). Figure 1 depicts the organization and relationships among elements of the site. The

upper half of the diagram depicts a self-sustaining project culture, made up of a shared sense of "who we are and what we do" as MTS project teachers, available "matching" technologies and tools for doing it, and a social system for communicating about the project. The bottom half of the diagram shows another triangular relationship that depicts the individual teacher's interaction or interface with the larger social system. Note that the teacher is influenced by the tools and social system of the larger school culture, but also must reconciles his or her beliefs with his or her instructional actions.

Boot-Strapped by Outsiders and Principal

In the beginning were the Outsiders. The least amount of time anyone of them spent on site was two days a week, thus in a very short time all the Outsiders were very much a part of daily life on the site. They went to TGIF's; they shared lunch and gossip; on occasion they substituted for teachers pulled out of classrooms; they received jotted notes in their mailboxes. Despite this comfortable presence and acceptance, Outsiders were rarely approached for help. Indeed the first year's research report is saturated with descriptions of partially successful attempts to create easy communication channels between teachers and the on-site experts: Special Interest Groups formed around teachers' technology interests; in-house newsletters; formal assignment of "buddies" for each expert to mentor.

All these fell short of influencing all or even most teachers. Instead, teachers gravitated toward natural networks of friendship and compatible personalities. A few teachers, four of the six who later became Facilitators, did approach the Outsiders and form collegial relationships with them. It may be that these teachers felt the most secure about revealing their own instructional beliefs and processes to others (Lieberman, Saxl, & Miles, 1988).

The consultants managed to make their influence felt in other more subtle but very powerful ways by selecting the array of available equipment, organizing occasions for talking about teaching and technology, and endorsing or remaining conspicuously silent about teachers' doings.

The choice of equipment, arrangement of equipment, and talk about equipment all carried information about what was considered appropriate for teacher and kids to be doing. During the first two years of the project these consultants made all the decisions about purchases and training expenditures. Often they consulted with teachers through teacher meetings or in informal settings such as the teacher lounge, but usually the consultants were explaining their decisions or offering teachers choices within a constrained selection. For example, the consultants obtained a site license for *LogoWriter* and provided *LogoWriter* inservice classes for teachers; they discussed Papert's Mindstorms philosophy. They chose not to allow any drill and practice programs on site; nor allow for the installation of an instructional learning system, even when the ILS was offered free. They chose to place banks of computers in the hallways and to declare them under no one person's control. They chose to lease-purchase a photocopying machine exclusively for kids' use. They chose the vendors who would be showing products at an all-day technology faire. As teachers looked around and made sense of the growing technology environment in which they found themselves, there were many clear messages to be gleaned from the Outsiders' selection of tools on site: permit small group work; do lots of writing; have kids build things; explore mathematical principles; make abstractions concrete whenever possible and so on.

The Outsiders also influenced the network of communications among teachers. The principal turned over the first twenty minute of faculty meetings to the Outsiders to use for project topics: discussions, announcements, votes,

feedback, questions, opportunities. The Outsiders encouraged teachers to approach them in small groups or pairs, often making appointments to work with teacher pairs on the basis of interests or technology. This created specific formal settings for talking about instruction with a peer. Outsiders often volunteered compliments on teachers' work they had observed, helped with, or heard about. These spontaneous remarks might arise in the staff lounge over lunch, in the computer lab, after school, in hallways, wherever they might run into a group of teachers. Outsiders and the principal were frequently asking teachers what they were doing, what they had learned, what they needed or wanted. Outsiders set up an in-house newsletter that reported on instructional activities underway and commented on the features that made them appropriate. As a result, by the end of the second year teachers and principal knew who were considered the best tech-integrated, student-centered teachers.

Who We Are

In the successive years as Outsider influence waned under increasing presence of the Facilitators, the values they had held remained deeply embedded in the site in the tools available and the communication structures they had established. The Facilitators who took over the project had all been "blessed" formally and informally by the Outsiders prior to their becoming Facilitators. In a very real sense the Facilitator teachers had been mentored into their current understandings and values. Thus "who we are and what we do" was partly defined by the initial influence of the Outsiders. It was also shaped by the personalities and goals of the Facilitators themselves.

During the last two years of the project the Facilitators became responsible for sustaining and continually defining the project culture: who we are and what we do. They did this through management and expansion of the tools on site;

through an elaborate formal social system of meetings: Facilitator, Grade Cluster, and faculty meetings; and through contacts with individual teachers in their role of Facilitator. These teacher-leaders did not only lead by drawing out others, they led by submitting or committing themselves to new ideas, new information, and new skills (Lieberman, Saxl, Miles, 1988).

Faculty and Cluster meetings were places where facilitators could and did exert influence, guiding their fellow teachers in many of the same ways that the outside consultants had: pointing out (rewarding) behaviors they approved of, offering reasons why certain choices were "bad," demonstrating software, management techniques, or instructional methods that supported a "student-centered" approach. Group-decision making was an important tool in the hand of the Facilitators.

Grade Cluster meetings were often convened to get feedback on decisions the Facilitator group was considering, to make decisions about the expenditure of cluster funds, or to conduct an inservice for Grade Cluster teachers, e.g., on Lego and the primary grades curriculum. In Cluster meetings the two Facilitators for the Cluster gently but firmly guided teachers away from bad choices. They also set agenda items that occasioned discussion of instruction, for example, modeling the how to plan a project-oriented unit of instruction. Their modeling told the teachers what to do and how to do it.

Meetings of the six (later five) Facilitators were held after school, usually monthly or as decision deadlines came up. Facilitators discussed issues of common concern, creating "policies" or recommendations which they would then share with the rest of the faculty in regular faculty meetings. They sometimes planned school-wide in-service training, though very early in their tenure they agreed to allow each cluster to organize its own in-service according to perceived needs. Often Grade Cluster Facilitators shared frustrations or

concerns about colleagues and received suggestions from the group. The Facilitators reinforced each other's understandings and commitment to the project. They lifted spirits, solved problems, joked, and argued.

Faculty meetings were forums for sharing information too. The principal usually asked specific people to share what they were doing. Facilitators reported on plans and decisions, announced policies, raised problems for group discussion of solutions.

Generally speaking a great deal of interaction between teachers, especially on the topics of technology and instruction, occurs on site. This talk reconfirms "who we are and what we do," and reconciles identify with technology use.

Individual Beliefs and Practices

The lower half of Figure 1 describes the interface between individual teachers and the larger culture of the school project. The degree of connection or closeness of connection between the individual teacher and the tools and social system moderates the amount of influence those elements have on the individual teacher's activities and beliefs. Indeed, the four teachers on site who are the least well developed in terms of the project (mired in Disjointed Use) are also the least well connected to the larger social system of the Facilitators and Grade Clusters. They miss meetings, happen to be sick on the days they are supposed to share at the faculty meeting, have conflicts that prevent them from attending inservice or conference opportunites, and generally resist quite successfully the advances of their peers. They are viewed as resistant by regular teachers and Facilitators, and the principal has confided her hope of eventually driving them out of the school site. They are, in short, social outcasts, and as the social system carries the most information and support, their outcast status continues to prevent them from developing further.

Conclusions and Their Meaningfulness

Almeda has been at The School for twenty years; she is nearing retirement. For the four years of the project Almeda taught from the front of the room, marching straight through lessons with or without the attention of the class. For four years her students' greatest experiences with computers were to use them for word-processing or drawing pictures for reports. Almeda was caught in the Disjointed Use stage of technology use. This Fall, for the first time ever Almeda organized her students' desks in clusters for group work. She approached the project administrative assistant and asked for help developing a group project unit on prehistoric times. Together the two of them planned a fairly complicated unit involving kids in clans (group work), projects (sand painting, making clothing), cross-curricular themes (bartering and math), and student simulation activities (a day without language). She was pleased with the results enough to repeat the template in a unit on Chinese dynasties. She has invited another teacher, one new to the site and the project, to team with her on the dynasties unit.

On Behalf of the Power of Culture

What happended to Almeda? Why didn't she turn over in the earlier years of the project? Why was she finally able to approach someone for assistance? The answers to these questions will probably never be answered empirically. But we do know that Almeda is in closer touch with the current social system at school. In fact, recently Almeda stepped forward into a high profile leadership role by volunteering to represent the school on a district social studies curriculum committee. We know that Almeda can and does approach her peer Facilitators

though she had not be able to do so when the outside consultants dominated the scene.

We see evidence of the power of the culture in its ability to move longtime hold-outs (e.g., Almeda) and to quickly and fairly painlessly bring new people on board (see the appended Conversation with Beth B.). Over the last five years the MTS project has demonstrated that:

- its teachers bring to technology a set of beliefs about the nature of instruction and their role in it;
- these beliefs affect the sense (and use) teachers make of the technological tools at their disposal;
- these beliefs are influenced by a pervasive social system or "culture" which describes acceptable instructional practices, which in turn affects the pool of technological tools available on site;
- and, that the influence of the social system on a teacher is a function of the teacher's relationships in the social system.

Making Teacher Change

To help one teacher change that teacher needs to be provided with tools for working with the new ideas. For MTS teachers those tools included things like a matrix or template for planning cross-curricular projects. Teachers also need conversation about instruction; someone to observe; opportunities to share and hear what others have to share. But what we learn from MTS is that you can't just provide those items. They don't come wrapped separately. They are the consequences of a school culture or social system.

School cultures cannot be implanted either, though the metaphor of growth does work here. Rather they are seeded and nurtured until they can

drop roots and carry on with minimal assistance. At MTS there were three important steps in the seeding process:

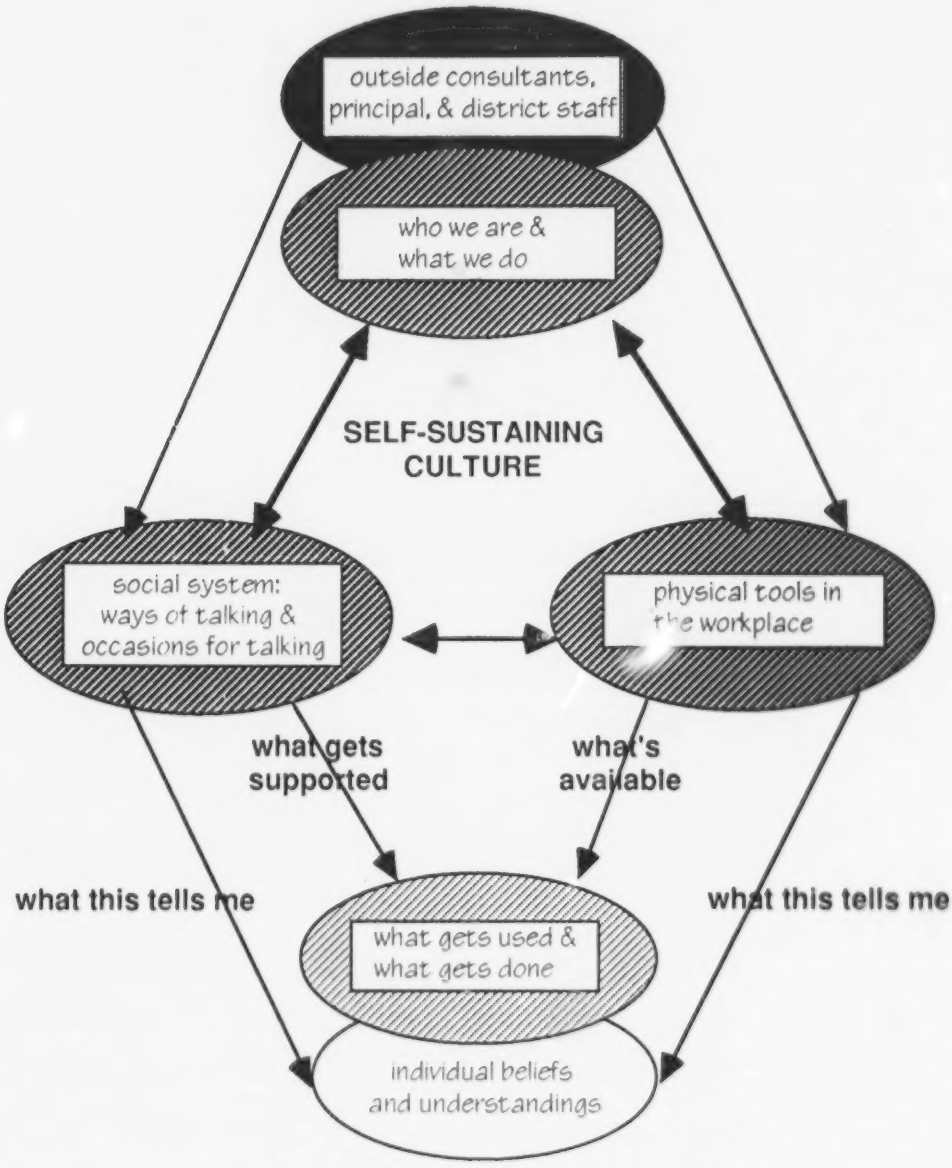
1) Using (money) outside consultants, the principal, and supportive district administration the project established an environment that matched and embodied the ideas of the project. They established communication structures and opportunities for the locals to talk to each other and to them. They supplied conceptual tools and modeled their use.

2) As the project moved along the outsiders identified a cadre of teachers who were quickly catchng on to the "big ideas" and processes of the project. They nurtured these people and through their outsider status marked them as leaders on the site.

3) The cadre of leaders empowered itself by gradually taking over the management and decision-making functions of the project. The re-established themselves as the support group for teacher in place of the Outsiders. For many veteran teachers this made all the difference in the world.

The outsiders served as the models and conduits for new ideas on the site. They identified the potential leaders and passed on to them their knowledge, techniques, and confidence. They kept "in touch" in the background to support the new teacher-leaders as they began to take over the project. In short, they seeded and nurtured the culture, but surely it is the locals themselves that made it grow into what it has become.

A SYSTEM OF TEACHER DEVELOPMENT


outside consultants, principal, & district staff
who we are & what we do
SELF-SUSTAINING CULTURE
social system: ways of talking & occasions for talking
physical tools in the workplace
what gets supported
what's available
what this tells me
what this tells me
what gets used & what gets done
individual beliefs and understandings

CONVERSATION WITH BETH B.

Beth B. is a second year teacher; she teaches 3rd grade.

I'm a lot more excited about this year because I know more about the curriculum and I know how to tie it in. And I'm trying to do projects more. Last year it was kind of like computers and [then] everything else and this year it's kind of part of the whole curriculum.

I would never have known how to do that unless Vicki showed me what to do. Cause I was brought up, okay we teach science, we teach art, and we teach this. And you can still have an area timed for social science — this is our social science time — but in that [time] we then do math, science, literature.

I love it. It's great. I think they're a lot more motivated. I have kids coming back to me, they're in fourth grade, going Mrs. B you never did that with us last year. I think they're a lot more motivated and they want to do the projects. We starting each unit by reading a book about that, weaving that in. And it's more interesting for me to teach too.

Understanding the Project Values:	We're doing newspaper from the past. Learning about Calif. Indians. So they're going to write. Each group has an aspect of the California - the dress, the clothing, whatever. And that's gonna be part of the newspaper from the past. The next unit we're doing after that is pioneers and we're gonna do Little House in the Big Woods. And we're gonna write about how they dressed and how they ate, and then we're going to compare to now 'cause that's a third grade curriculum.
•group work •thematic or cross-curricular instruction •literature centered language arts	
•alternative assessment	After I teach a lesson we'll go to the computer lab and I'll say "OK now brainstorm everything you remember. It's sort of like an assessment. It is an assessment of how much they've learned.

getting the message that you're not doing it...	I was getting really frustrated. I would look around and see all these teachers doing these Mayan Temples and I think 'Well I don't know how to do that and what does Mayan Temple have to do with the computer? Someone else was doing designs in math on it. And I kept noticing all these people were doing these things and I was a little shy and I thought everyone was too busy and I didn't really know what to do.
getting help from a Facilitator	And this year they had facilitators after school and I said Vicki, this is my unit. I don't know what to do, can you help me? And we put together a project that I could do. So it was more my going out and asking can you help me.
a "tool" in the culture, passed down from Outsider to Facilitator to teacher	And then they showed me how you can wrap around you do a big circle and you make a web. You put your main topic in there and everything else goes out, and it all dealt with computers: computers and math, computers and science. It was just a one meeting. And she got out a big long computer sheet and we just kept going — okay now what about science, how can we tie this in with science and how can we tie it in with art?
making sense: learning by doing	That was what got me started to thinking about other curriculum —other areas Then I thought, when we had a [pupil-free training] day where we worked on social science using the computer lab — and I used that day and I made my circle and I put Little House in the Big Woods and I go, well what could we do, what can we do for science? I
teacher helping teacher	That's one thing I haven't done I'd like to do. Interviews. Now Joey's given us all a sheet of the kids [who can shoot and edit video], Video Vikings, so I now I know can you come teach me how to do this

reinventing yourself; reconciling "what I do" with "what I believe"	I think you really limit yourself when you say no I've never used computers I don't see any value in it. Just because other people's ideas about how to use it don't click with your ideas if you just keep asking people eventually you're going to hit someone who has the same kind of idea that you do about how to use it. I wouldn't give up on it. I came here thinking, "Great. Technology." Then I got into it myself and was trying to apply it to the old way that I had been thinking. You have to kind of change your way of thinking [about instruction] and make a project out of it. I felt like it didn't fit in to anything; I thought this is an hour when I could really be teaching social science and now I'm using that hour to teach social science. It wasn't a separate class it was social science.

NOTE 1.

Unstructured Observation and Interview. On-site observations were carried out by the elementary site research coordinator with graduate research assistants. Observations took place in classrooms, the basement computer lab, the upstairs and downstairs hallway computer banks, the MTS staff work area, school faculty meetings, parent training classes, local advisory board meetings, school open house, PTA meetings, staff lounge, the school library, the playground, the auditorium. Observations were taken during class, recess, lunch, before and after school. Exclusive of MTS management team meetings, approximately fifty observation days were spent on site: thirty-five by the co-coordinator in charge of field observations, and approximately twelve additional observations were completed by graduate assistants. Observers' field notes included accounts of teacher and student talk and behavior. Observers recorded a cohesive chunk of instruction (e.g., bounded by subject matter markers in most cases, sometimes by time markers like recess or lunch). Observers frequently asked students or teachers for clarification about events or purposes, and frequently students and teachers voluntarily "filled in" the observers. Upon completing an observation, the observer elaborated on her notes.

Participant observation. Throughout the project the researcher straddled the line between participant and observer. In the first three years of the project, participation opportunities and actions were mostly confined to responses to invitations from teachers, principal, and students to solve technology problems on the spot or to react to suggestions and ideas. In year four the researcher participated to a greater extent in the teacher training meetings, offering suggestions or providing additional resources for the lead teachers (for example, on portfolio assessment). A research associate worked the 7th/8th grade social science teacher to develop a unit around a simulation package. In the fifth year

of the project the researcher began by helping the science teacher plan an elective course and ended up offering an elective course on HyperCard and literature to a handful of 7th and 8th grade boys "at risk." All participation did not detract from the time spent in observation, but rather simply increased the amount of time on site, the number of conversations and interactions with staff and students.

Document Content Analysis. A number of documents were gathered on site and analyzed as evidence of concerns, foci, mandates, opportunities, etc. The following is a partial list of the kinds of documents gathered by the researchers: district announcements of in-service offerings; principal's memos; MTS project staff memos to teachers and to each other; sign-up sheets for the basement computer lab, the camcorders, and auditorium; the software checkout; teachers' assignments for students; student printed work; the school newspaper; the *MTS Marker* and *Recycler;* school site plan and student handbook; memos about the project or about curriculum sent to parents; documents about the project prepared for school visitors; parent computer check-out sheets; and quarterly reports from MTS staff to the State. Teachers were also asked to maintain "logs" or journals of their reactions and experiences during the year. As expected, most did not. Two teachers provided irregular and infrequent records. Many teacher sought out the researchers to relay their own versions of classroom incidents, "problems" and complaints.

References

Barth, R. (1991). Improving schools from within. San Francisco: Jossey-Bass.

Bogdan, R. & Biklen, S. (1992). Qualitative research for education. Second edition. Boston: Allyn & Bacon.

Cochran-Smith, M. (1991). Word processing and writing in elementary classrooms: A critical review of related literature. Review of educational research, 61(1), 107-155.

Collins, A. (1990). The role of computer technology in restructuring schools. In Sheingold & Tucker (Eds.). Restructuring for Learning with Technology. Center for Technology in Education and the National Center on Education and the Economy, 610 W. 112th Street, New York, NY 10025.

David, J. (1990). Restructuring and technology: Partners in change. In Sheingold & Tucker (Eds.) Restructuring for Learning with Technology. Center for Technology in Education and the National Center on Education and the Economy, 610 W. 112th Street, New York, NY 10025.

_____, (1989a). Restructuring in Progress: Lessons from Pioneering Districts. Results in Education Series. Washington, D.C.: Center for Policy Research in Education, National Governors' Association. Also available as ERIC document 306-633.

Dwyer, D, Ringstaff, C., Sandholtz, J. (1990a). Teacher beliefs and practices. Part I: Patterns of change. ACOT Report #8. Apple Classrooms of Tomorrow. Advanced Technology Group, Apple Computer Inc., Cupertino, CA.

Dwyer, D, Ringstaff, C., Sandholtz, J. (1990b). Teacher beliefs and practices. Part II: Support for change. ACOT Report #9. Apple Classrooms of Tomorrow. Advanced Technology Group, Apple Computer Inc., Cupertino, CA.

Erickson, F. (1986). Tasks in times: Objects of study in a natural history of teaching. In Zumwalt (Ed), Improving teaching. 1986 ASCD Yearbook. Alexandria, VA: Association for Supervision and Curriculum Development.

Fiske, E. (1991). Smart kids, smart schools. New York: Simon & Schuster.

Hawkins, J. (1987). The interpretation of Logo in practice. In Pea & Sheingold (Eds.) Mirrors of Minds. Norwood, NJ: Ablex.

Lieberman, A., Darling-Hammond, L., & Zuckerman, D. (1991). Early lessons in restructuring schools. National Center for Restructuring Education, Schools,

and Teaching (NCREST), Teachers College, Columbia University, New York, New York, 10027.

Lieberman, A., Saxl, E., & Miles, M. (1988). Teacher leadership: Ideology and practice. In Lieberman (Ed.), Building a professional culture in schools. New York: Teachers College Press.

Little, J. (1990). The mentor phenomenon and the social organization of teaching. In Cazden (Ed.), Review of Research in Education, volume 16. Washington DC: AERA.

McLaughlin, M. (1990). The Rand change agent study revisited: Macro perspectives and micro realities. Educational resesarcher, 19(9), 11-16.

Palumbo, D. (1990). Programming language/problem-solving research: A reveiw of relevant issues. Review of educational research, 60(1), 65-89.

Papert, S. (1990). Foreward in I. Harel (Ed.) Constructionist Learning: A 5th Anniversary Collection of Papers. Epistemology and Learning Group, MIT Media Laboratory, 20 Ames Street, Cambridge, MA 02139.

_____, (1987). Computer criticism vs. technocentric thinking. Educational Researcher, 16(1), 22-30.

Pea, R., Kurland, M., & Hawkins, J. (1987). Logo and the development of thinking skills. In Pea & Sheingold (Eds.) Mirrors of Minds. Norwood, NJ: Ablex.

Pearlman, R. (1991). Restructuring with technology: A tour of schools where it's happening. Technology and Learning, 30-36.

_____, (1989). Technology's role in restructuring schools. Electronic learning, 8-9, 12, 14-15, 36.

Polin, L. (1991). Teacher development through collaboration. Paper presented at the annual meeting of the American Educational Research Association, Chicago.

_____, (1990). Observations of classrooms in transition. Paper presented at the Annual Meeting of the American Educational Research Association, Boston.

_____, (1987) Factors affecting the implementation of a computer-based language arts curriculum. Paper presented at the Annual meeting of the American Educational Research Association, Washington, DC.

_____, (1986) Making sense of research on Logo. Invited presentation at the Fall Conference of Computer-Using Educators, San Jose, CA.

Romberg, T. & Price, G. (1983). Curriculum implementation and staff development as cultural change. In Griffin (ed.) Staff development: Eighty-second yearbook of the National Society for the Study of Education. Chicago: University of Chicago Press

Sarason, S. (1982). The culture of the school and the problem of change. Boston: Allyn & Bacon.

Schon, D. (1983). Educating the reflective practitioner. NY: Basic Books.

Sizer, T. (1992). Horace's school. Boston: Houghton Mifflin.

White, Paula A. (1989). An overview of school-based management: What does the research say? *NASSP Bulletin, 73(518),* 1-8.